CLAIMS

1. An electrolytic capacitor comprising an anode layer of a valve metal foil having through holes and a coarsened surface, a dielectric layer of a oxide film by anodizing a part of the surface of the metal foil, and a cathode layer on the dielectric layer,

wherein the cathode layer is an electrolytically-formed conductive polymer layer formed to make contact with the dielectric layer.

2. The electrolytic capacitor according to Claim 1

wherein the cathode layer contains a cathode-side conductive polymer layer is formed on one side of the anode layer, and the electrolytically-formed conductive polymer layer covers the other side of the anode layer so as to make contact with the dielectric layer of the oxide film and electrically connected to the cathode-side conductive polymer layer.

3. The electrolytic capacitor according to Claim 2, further comprising a electric collector,

wherein the electric collector is a metal foil which is formed on one side of the anode layer via the cathode-side conductive polymer layer.

4. The electrolytic capacitor according to any one of claims 1 to 3, wherein the cathode layer includes another conductive layer is formed so as to make contact

with the dielectric layer, and the electrolytically-formed conductive polymer layer is formed on the dielectric layer so as to cover the another conductive layer.

5. The electrolytic capacitor according to any one of Claims 1 to 3, wherein a metal surface portion for an electrode is formed at a part of the anode layer of the valve metal foil.

6. The electrolytic capacitor according to any one of Claims 1 to 3, wherein the radius of the through holes is not more than the thickness of the valve metal foil.

7. The electrolytic capacitor according to one of Claims 1 to 3, wherein the area ratio of the through holes to the main surface is not more than 10%.

8. A laminated electrolytic capacitor which is obtained by laminating a plurality of the electrolytic capacitors according to Claim 5, wherein the laminate is provided with an anode-leading electrode electrically connected to the metal surface portion of each valve metal foil and a cathode-leading electrode electrically connected to the electrolytically-formed conductive polymer layer directly or indirectly.

9. The electrolytic capacitor which is obtained by winding the electrolytic capacitor according to one of Claims 1 to 3.

10. The electrolytic capacitor according to one of

Claims 1 to 3, wherein the valve metal foil is made of aluminum.

11. The electrolytic capacitor according to one of Claims 1 to 3, wherein the electrolytically-formed conductive polymer layer contains a heterocyclic 5-member compound.

12. A method of producing an electrolytic capacitor comprising an anode layer formed of a valve metal foil having through holes and a coarsened surface, a dielectric layer of a oxide film formed by anodizing a part of the surface of the metal foil, and a cathode layer, wherein the method comprises steps of:

forming a electrolyzing electrode on one side surface of the valve metal foil; and

immersing the valve metal foil in a conductive monomer solution, another electrode being disposed in the solution on the other side of the electrolyzing electrode to the valve metal foil and,

polymerizing the monomer by electrolyzing the solution between the electrolyzing electrode and said another electrode, to form a electrolytically-formed conductive polymer layer, as a cathode layer, which is attached on the surface of the oxide film on the valve metal foil.

13. The method according to Claim 12, wherein the electrolyzing electrode is a cathode-side conductive

polymer layer, the electrolytically-formed conductive polymer layer and the cathode-side conductive polymer layer being used as a cathode layer of the capacitor.

14. The method according to Claim 12, wherein the electrolyzing electrode comprise a cathode-side conductive polymer layer and a metal foil provided on the cathode-side conductive polymer layer, thereafter, the electrolytically-formed conductive polymer layer and the cathode-side conductive polymer layer being used as a cathode layer of the capacitor, and the metal foil being used as a cathode electric collector.

15. The method according to any one of Claims 12 to 14, wherein the method, prior to the polymerizing step, comprises a step of partly forming a conductive layer on the surface of the dielectric layer.

16. The method of producing a laminated electrolytic capacitor, wherein the method further comprises steps of:

laminating a plurality of the electrolytic capacitors according to Claim 12 to obtain a laminate;

connecting a common anodic wiring electrode to the metal surface portion of each valve metal foil of the laminate; and,

connecting a common cathodic wiring electrode to each electrolytically-formed conductive polymer layer of the laminate.

17. The method of producing a laminated electrolytic capacitor, Wherein the method comprises steps of:

laminating a plurality of the electrolytic capacitors according to Claim 13 to obtain a laminate;

connecting a common anodic wiring electrode to the metal surface portion of each valve metal foil of the laminate; and,

connecting a common cathodic wiring electrode to each cathode-side conductive polymer layer of the laminate.

18. The method of producing an electrolytic capacitor, wherein the method comprises steps of:

laminating a plurality of the electrolytic capacitors according to Claim 14 to obtain a laminate;

connecting a common anodic wiring electrode to the metal surface portion of each anode valve metal foil of the laminate; and,

connecting a common cathodic wiring electrode to each cathode electric collector of the laminate.

19. The method of producing an electrolytic capacitor according to one of Claims 16 to 18, wherein the method further comprises a step of anodizing a part of the anode valve metal foil again, after the metal surface portion is connected to the anodic wiring electrode and before one of the electrolytically-formed conductive polymer layer, the cathode-side conductive polymer layer

and the cathode electric collector is electrically connected to the cathodic wiring electrode.

20. The method of producing a wound electrolytic capacitor according to one of Claims 12 to 14, wherein the method further comprises a step of winding an electrolytic capacitor in the shape of a coil.

21. The method of producing an electrolytic capacitor according to Claim 20, wherein the method further comprises a step of anodizing a part of the anode valve metal foil again, after the electrolytic capacitor is wound in the shape of coil.

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